Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of:	)	
Carrier Current Systems, including Broadband over Power Line Systems	)	ET Docket No. 03-104

RESPONSE TO NOTICE OF PROPOSED RULE MAKING

The following are comments to various paragraphs and sentences, as presented in ET Docket No. 03-104. I will address each section/sentence separately with appropriate reference back to the originating document.

In Paragraph 22, Sentence 3 of the NPRM, it states:

"*Southern states that there is a high degree of variability in the ability of the power lines to radiate BPL signals and that signals on power lines will tend to cancel each other out.*"

I have to agree with the comment concerning the high degree of variability in terms of cancelling out signals but because of the design of parallel-line power transmission facilities, there will be little cancelling of the signals unless some criteria are met. In order for a balanced pair of wires that carry matched, opposite polarity signals to cancel out their radiation, they have to be in very close proximity to each other and have no standing waves present.

As an example, a non-radiating balanced antenna feeder of 450 ohms impedance has wiring spaced approximately 1.25" apart. The high voltage overhead cables that are south of my residence appear to be approximately 35-40 feet apart and starting at approximately 45 feet from the ground. Using the equation for two-wire parallel wire transmission impedance:

Zo = [276/sqrt(k)]*[log(d/r)]

where:

Zo = characteristic impedance in ohms
k = permittivity of the insulation medium (air = 1)
d = conductor separation in inches
r = conductor radius in inches

and assuming a cable radius of 0.75 inches and a horizontal separation of 35 feet, the calculated characteristic impedance is approximately 760 ohms. In order to prevent radiation from the parallel wires, the distance between the wires has to be a very small in relation to the signals wavelength and the source and receiver impedances have to match the characteristic impedance of the transmission line to minimize the issue with standing waves and their ability to radiate from an unmatched balanced transmission line.

If there are any out-of-phase standing waves present on the power transmission lines, the wiring will act as a two-element gain antenna and magify any signal that is on the cables at that time. Anyone who uses directional antennas relies on the phasing of signals from various antenna elements to achieve the desired transmission pattern. In order to achieve the same line coupling that I have on my balanced feedline, given its 1.25" spacing and and operation at 3.985 Mhz, the frequency of the carrier on the power transmission line would have to be approximately 12 kHz. Also, the distance separating the transmission lines is ¼ wavelength at approximately 7.1 Mhz and can act as a multi-lobal gain antenna system if there are any standing waves present in the system.

Paragraph 22, Sentence 4, of the NPRM states:

"*...that a BPL signal injection point can appear like a point-source radiator, with the power line having characteristics between a waveguide and antenna.*"

I disagree with this two-part assertion. The injection point will not act as a point-source radiator. The point-source radiator is equivalent to the isotropic radiator, which is a theoretical device and radiates equally in all directions. Any unshielded wiring will act as a radiator and give off RF emissions. This will not be equivalent to the ideal point-source radiator. There should be no RF radiation from the injection point at all.

The second presented concept that the power line will have "characteristics between a waveguide and antenna" is specious on its face. A waveguide is a hollow metallic tube, either round or rectangular in shape, and acts as a conduit of the radiated RF energy with the metal tube being at ground potential. The operation is akin to a coaxial cable where the center electrical conductor conducts the RF energy and the shield is at ground potential and acts as a shielding element. A wire is a single piece of conductor that will conduct electrical energy. As the frequency increases on a conductor, the electrical signals travel more on the outside of the wire than on the inside. This phenomena is called "skin effect" and can be beneficial depending on the application as where a pipe can be used as a conductor instead of a whole wire. Since there is no shielding around the wire at ground potential, the wire will radiate some of its energy into space. The efficiency of this coupling of RF energy to the ether depends on the wires characteristics and the signals that are being carried by the wire.

In Paragraph 23, sentence 2-3 of the NPRM, it states:

"Ameren Energy Communications Inc. (AEC) states that the notion that the power lines will act as efficient antennas and pollute their surroundings with harmful interference is not supported by scientific measurements.67 AEC asserts that because of impedance mismatch in real-world power lines, a single power line is expected to be a rather inefficient radiator."

Any unshielded wire is both a radiator and receiver. This applies in all electrical applications. This is the reason that grounded shielding is necessary to prevent the ingress or egress of unwanted emissions. The wire becomes a less efficient radiator as the wire length becomes less than ¼ wavelength of the frequency that the wire is carrying. As the wire becomes longer than ¼ wavelength at the frequency in question, the radiation pattern transforms from a dipole pattern to a multi-lobed pattern displaying signal gain above the dipole pattern. This increase in gain is dependent upon length of the wire and height above ground.

Many Amateur Radio operators use long wire antennas for communications and operate them as non-resonant or harmonic antennas. As long as the feedline is matched to the presented antenna impedance, maximum power transfer will take place and maximum signal radiation occurs. The radiation pattern will be multi-lobal but radiation will take place. The efficiency of that radiation can either be determined empirically or by modeling the antenna system in accepted software such as NEC-4.

In terms of coupling energy into the cabling, the most efficient energy transfer occurs when the impedances of the driving source and the receiver match the characteristic impedance of the wiring, in this case the power transmission lines. When this match occurs, the most energy is transferred to from the source to the destination with the least amount of energy being wasted in standing waves that can radiate from a balanced line.

In Paragraph 24, Sentence 1 of the NPRM, it states:

"*...only two BPL devices in the same area can operate simultaneously, and even those two devices would operate on different frequencies, so they cannot affect the same receiver.*"

One of the largest issues that users of RF have to contend with is Intermodulation Distortion (IMD). This occurs when two or more signals electrically mix together and create multiple sum and difference frequencies that have the possibility of causing interference to other services. This process is exacerbated by non-linear processes, such as rectification that can occur at oxidized connections or amplifiers that are overloaded and operating non-linearly.

This issue rears its ugly head usually on the very congested VHF and UHF bands when the resultant IMD products happen to lie on the input to a repeater and cause transient keyup as long as the errant signal is present. Tracking down this type of interference is very difficult because of the reliance of many conditions to be present.

This applies to BPL in relation that if there are any connections that are possibly corroded and can cause some signal rectification, the mixing of the BPL signals being imposed on the power lines plus the received signals that the power lines receive from all the RF broadcast services, could yield a nasty mix of IMD products with these IMD products being re-radiated by the power lines themselves.

A classic example of IMD caused by power line reception of RF signals involves a case in the Cincinnati, Ohio area involving power lines that are operated by Cinergy and reradiating intermodulation products from WLW-AM. This is documented in a letter sent to WLW and Cinergy from FCC Special Counsel Riley Hollingsworth dated 17 December 2001. Please reference the following webpage: http://www.arrl.org/news/enforcement_logs/2001/1229.html. The cause of the problem was related to non-linear junction issues involving wiring on a 345-kV power system resulting in intermodulation between WLW's broadcasted signal and the 60 Hz power line frequency. Please reference the following webpage: http://www.arrl.org/arrlletter/02/0531/ for further information from "The ARRL Letter" dated 31 May 2002. This whole issue was caused by received signals and not by transmitted signals being carried on the wires. Please reference the above discussion concerning Paragraph 23, sentence 2 & 3 of the NPRM.

In Paragraph 25, Sentence 2 of the NPRM, it states:

"*Southern states that emissions from its system are compliant with Part 15 measurements and, in fact, tend to be in the noise floor.*"

This comment is, by its wording and nature, specious at best. The definition of "noise floor" is the aggregate sum of electrical or RF signals present, at the point of measurement, when the signal of interest is not present. For example, in 47CFR15.209 (a), it states that the limit for radiated signals to meet Part 15 limits in the 1.705 – 30 MHz frequency range is 30 uV/m at a distance of 30 meters from the device or system under test.

It is entirely possible that the noise floor at the measuring site could have exceeded the 15.209 (a) limits even before the addition of the BPL carriers and the addition of the carriers did not show up because of the masking properties of the noise that is present. This statement as presented by Southern would be valid provided that the measurement value of the noise floor before the addition of the BPL carriers was provided as a reference point for the measurements.

In regards to Paragraph 31:

I wholeheartly disagree with this assertion that the systems can be operated and maintained under Part 15. Currently, as indicated by many letters sent out by FCC Special Counsel Riley Hollingsworth, power companies have to be told of their obligations under Part 15 rules that they have to solve the complaints of radiated noise coming from their power grid. These situations have to be pursued by the complaintant as the power companies are not engaged in active searching of noise generating locations and that their transmission systems are in regulatory compliance. This puts the burden of diagnosis and location onto the offended and not on to the offender. If the offended happens to be a mobile user, remedy will almost be not possible at all.

As Amateur Radio operators are required by FCC Part 97 rules to maintain correctly functioning equipment that does not interfere with other radios or services, the Access BPL systems need to be actively monitored for compliance in regards to Part 15 emissions as there are people who are out there who use radio services that may not know that they are being interfered with because of their lack of knowledge in the subject of RF and EM interference.

In Paragraph 35, Sentence 2-3 of the NPRM, it states:

"*In considering this interference potential, we note that ARRL acknowledges that noise from power lines, absent any Access BPL signals, already presents a significant problem for amateur communications.92 We therefore would expect that, in practice, many amateurs already orient their antennas to minimize the reception of emissions from nearby power lines.*"

I have to agree with sentence 2 here. At my location, I use a fixed 'Inverted L' design antenna. The vertical section goes from ground level to 25 feet and the horizontal leg runs 95 feet from the NW to the SW. The antenna by nature is fixed as I live in rental housing. The antenna is connected to the transceiver via 100 feet of RG-8X coaxial cable. Accounting for an approximate .7 db loss in the cable, the receiver shows, on the average, a S-9 (50 uV across 50 ohms) noise reading integrated over a bandwidth of 2.5 kHz at a received carrier frequency of 3996.00 kHz. There are other locations in the state of Wisconsin where the noise is practically non-existent. If I have a power line misbehave in the area, the noise level at my station location can increase 10 db rendering weak-signal communications almost impossible.

I have to disagree completely with sentence 3 here. An Amateur Radio operator will orient his/her antenna, if they have a movable antenna, to maximize the reception of the desired signal, irregardless of any radiating noise sources. A station that has a fixed wire antenna will usually orient the antenna in a way to accommodate the length of the antenna and install it for omnidirectional coverage. There are some stations that may have the luxury of having separate transmit/receive antennas that can be oriented differently but these installations are in the extreme minority. The ability of an Amateur Radio operator to install antennas to pursue the hobby is quite dependent on where they live, property size, CC&R's, local regulations, etc. The idea that antennas are oriented to minimize noise just does not stand up when it comes to practical application.

Paragraph 36, Sentences 1-3 of the NPRM states:

"We also disagree with ARRL and others that suggest that interference caused to amateur and other radio operations by Access BPL systems complying with our Part 15 limits will be widespread. Although we agree with ARRL that Access BPL on overhead lines is not a traditional point-source emitter, we do not believe that Access BPL devices will cause the power lines to act as countless miles of transmission lines all radiating RF energy along their full length. Rather, the primary source of emissions will be the individual couplers, repeaters and other devices and, to a lesser extent, the power line immediately adjacent thereto."

I disagree to the point-source emitter scenario. Please refer to comments concerning Paragraph 22, Sentence 4. Applying any kind of a signal to a wire will have the signal propagate down its length minus losses caused by line resistance and signal radiation. If this propagation down the wire did not occur, there would be no way that the wires themselves could be used for the transmission of 60 Hz electrical power as the electrical energy applied would be lost to impedance and radiational losses and not recovered at the other end of the trunk.

I also want to bring a practical example of my reasoning. While monitoring the 75 meter Amateur Band in my vehicle on my drive to work, I ran into a location along the way where the electrical noise would immediately rise in intensity as I proceeded along. After a mile of traveling, the noise level peaked and then proceeded to fall off for a mile. The noise source was traced to a pole mounted phantom power supply used for the cable system. The only reason that the noise did not gradually increase when I encountered the noise was that the affected trunk segment was isolated from other downstream trunk segments by manual disconnects. By practical experience, the above listed sentences in Paragraph 36 do not bear out in testing.

In Paragraph 38, sentences 1-3 of the NPRM, it states:

"*Accordingly, we are proposing to maintain the existing Part 15 radiated emission limits for Access BPL systems and devices. In addition, we are proposing to exempt Access BPL systems from the existing conducted emission limits of Section 15.107(c). Because Access BPL systems are installed on power lines that carry 1,000 volts to 40,000 volts, conducted emission measurements are very difficult to measure, and present safety hazards in connecting test equipment to these lines.*"

I disagree with this assertion and that 47CFR15.107(a-b) does not have to be waived in the case of Access BPL. The focus and process of the measurement just has to be changed. For example, there are several countries that allow operation in the 136 kHz band and the United States is not one of them because of power companies alleging that operation by Amateur Radio operators in that band segment would interfere with the power grid communications (FCC Report & Order RM-9404). The other countries are allowed to run up to 1 watt ERP. At these low frequencies, it requires modeling of the antenna system using software, such as NEC-2, to model the antenna gain, impedance, and pattern. This then allows a matching network to be designed and with available electrical network equations, back calculate the power needed at the final amplifier to yield 1 watt ERP.

Since it is in the purview of Amateur Radio operators to take accepted modeling and network design equations and processes to accommodate the requirements of using the 136 kHz band within their individual government's regulations, it is well within the purview of the Access BPL providers / installers to use the same processes to determine the amount of voltage being impressed onto the power lines. Knowing the design characteristics of the isolation networks, and the power line calculated impedance, the level of the conducted signal on the power lines can be calculated and the data transmitters adjusted accordingly. This would allow for the meeting of the currently written 47CFR15.107(a-c) regulations by stipulating the calculations and parameters used to determine meeting this regulation.

Members of The Commission:

There are too many interference issues and commentary based on false premises to give *carte blanche* permission for BPL service to take place. Any interference that is caused by BPL will not fall on the users or suppliers of BPL but the licensed services that rely on the use of the radio spectrum that BPL will be using. Plus, the BPL system itself will be subject to interference from the outside with the used power transmission wiring acting as receive antennae. I contrast this with the commentary provided in FCC Report & Order RM-9404 where the request of Amateur Radio operators to experiment in the 136 kHz band was denied because the power companies professed that the transmitted signals from Amateur Radio operations would interfere with power line control. Yet now the power companies want to install data equipment that will be affected by licensed transmissions occuring in the frequency bands being used to provide the Access BPL.

Even though there are claims that the power transmission wiring will not radiate the BPL carriers, this conclusion is not borne out in real life. Unshielded wiring will radiate its contents and that is not avoidable and part of the natural operation of unshielded wiring carrying electrical signals. We know that power lines conduct and radiate interference from attached defective equipment imposing their own electrical disturbances onto the distribution grid.

Other countries that have been testing this technology. Finland, Japan and Austria, have cancelled implementations of BPL because of the radiated interference to HF users. In Japan, the Ministry of Public Management, Home Affairs, Posts and Telecommunications (MPHPT) has ruled that it is too early to use BPL because of interference to users of the HF spectrum as indicated in "The JARL News" at http://www.jarl.or.jp/English/4_Library/A-4-1_News/jn0208.htm. In Finland, "The Finnish Minister of Transport and Telecommunications, Mr. Olli-Pekka Heinonen, had answered to the question of a Member of Parliament regarding the introduction of PLC in Finland: For the present, because of the technical problems encountered, introduction of PLC technology is not possible." This quote is from http://www.darc.de/referate/emv/plc/plc-oh.pdf and has the date of 16 May 2001. In Austria, the tests that were being performed in Linz, Austria were cancelled at the request of the Austria Government Ministry for Commerce, Innovation, and Technology because of massive interference to emergency services HF radio traffic being conducted by the Red Cross (reference: http://www.arrl.org/news/stories/2004/01/08/2/).

I suggest that before The Commission allows this RFI genie out of the bottle, The Commission should look into the use of the power transmission corridors to act as right-of-ways for fiber optic transport systems to perform the same tasks as BPL. Fiber optic cabling does not radiate their signals nor are they affected by external RF interference. Higher data transport speeds are possible over longer distances and can yield the same results or better. The issue with "the last mile" can be solved by using RF networking similar to the present 802.11a/b/g wireless protocols between Access Points atttached to the fiber network and individual subscribers using already allocated RF band segments.

Now according to a news release issued by Cinergy Broadband, LLC, a subsidary of Cinergy Corp. and Current Communications Group, LLC / Current Technologies, LLC, dated 2 March 2004 and available at http://www.cinergy.com/News/default_corporate_news.asp?news_id=420, are indicating that they are making services available by Access BPL to their consumers as this NPRM is still in its commentary period and no formal authorization has been made by the FCC allowing full installation of Access BPL facilities and transport. On its face, this announced action by the consortium of Cinergy Broadband, LLC, and Current Communications Group, LLC have the indications that the passage of the FCC's ET Docket No. 03-104 and ET Docket No. 04-37 are already a *fait accompli* and that the NPRM process that is currently being engaged in is just a legal formality that will have no bearing on the decisions of The Commission.

I want to thank The Commission for considering the above comments in the above mentioned NPRM.

Respectfully submitted,

/s/

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